Conexant Slashes Telecom Costs with Cisco QoS Solutions for Voice, while also Protecting SAP Traffic

Conexant System Inc., a $2 billion Rockwell International spinoff, is the world's largest independent provider of semiconductor system solutions for communications electronics. Conexant is deploying a New World, converged data/voice Frame Relay network made possible by Cisco quality of service (QoS) solutions—including QoS Policy Manager (QPM), Cisco IOS® software, the Catalyst® operating system (OS), Cisco routers, and Catalyst 6000 switches. Conexant experienced significant tangible benefits from implementing QoS. Domestically, for instance, a converged voice and data 256 kilobit per second (Kbps) Frame Relay permanent virtual circuit (PVC) provides Conexant with excellent voice quality and outstanding SAP application performance between the company's Santa Clara field office and Newport Beach headquarters, both in California. Internationally, Conexant is saving $4200 per month in voice toll calls between its Tokyo field office and Newport Beach headquarters, while also prioritizing SAP above background traffic.

CISCO SYSTEMS

The Drive to Convergence

Two factors drove Conexant to implement a converged network using Cisco QoS solutions: congestion and cost. As background traffic on its network exploded, Conexant's Frame Relay links became heavily congested. Mission-critical traffic from applications such as SAP Accounts Payable or General Ledger competed with non-critical traffic such as bulk file transfers and casual Internet browsing. During frequent periods of congestion, SAP users experienced long wait times—severely impacting financial updates and reports. Cost also became a factor, as Conexant is motivated to reduce costly voice toll-charges between each of its remote international offices and the headquarters in Newport Beach.

Conexant had initially tried a hardware-based competitive solution, but found that this approach did not scale well across its entire network, was cost-prohibitive, and did not support QoS mechanisms necessary to implement voice across the data network.

Conexant's goals were to reduce phone toll charges, prioritize SAP, and merge voice and data onto one PVC to reduce Frame Relay costs. The ability to merge data and voice would only be possible with robust prioritization and bandwidth management features that would ensure minimal delay and jitter for time-sensitive voice traffic.

"We're in the next phase of networking," says Randy Colvin, Conexant Manager of Network Hardware and Architecture, "where QoS features will transform how we handle all types of traffic over the network. Cisco has been an excellent partner, not only because of its well-known customer support, but also because Cisco provided the features we needed. We need many of the advanced voice QoS features in Cisco IOS Release12.0(7)T and QPM is the only policy manager offering support for features such as IP Real-Time Transport Protocol (RTP) Priority, cRTP, and Frame Relay Fragmentation (FRF.12) (below) that were needed for voice."

Advanced Cisco IOS QoS features used on Conexant's network

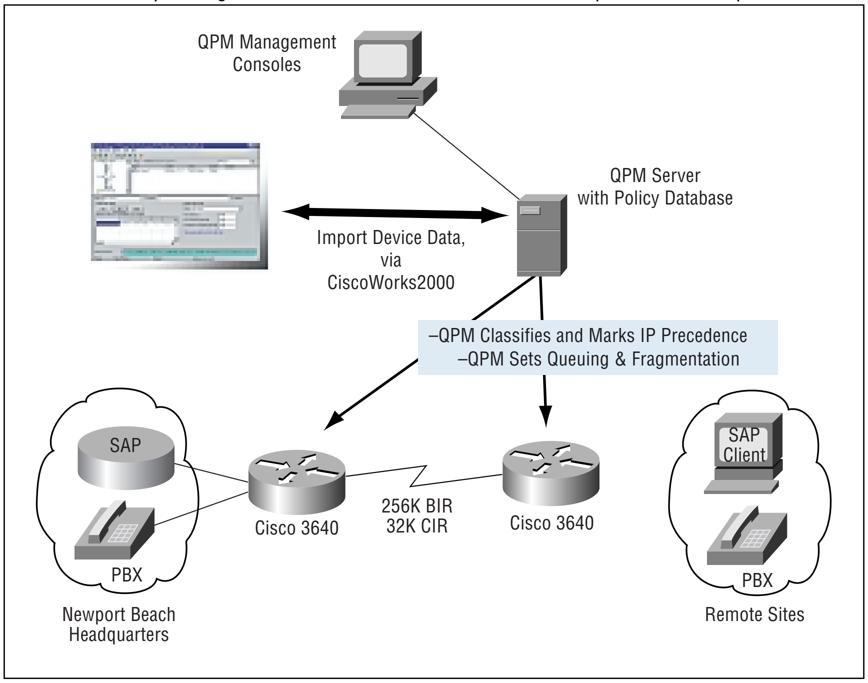
- IP RTP Priority—Minimizes delay and jitter for real-time applications on slow-speed wide-area network (WAN) links. IP RTP Priority provides a strict priority queue for real-time traffic, such as voice. This queue will always be serviced before any other traffic.
- Frame Relay Traffic Shaping—Minimizes packet loss by throttling back packets as they are forwarded into the Frame Relay cloud based on congestion indicators.
- Compressed RTP (cRTP)—Reduces unnecessary bandwidth consumption by compressing header size from 40 bytes to four bytes. The benefits of using cRTP for voice are apparent when considering that the payload for a voice packet is only 20 bytes.
- Frame Relay Fragmentation (FRF.12)—Ensures that voice packets aren't blocked behind large data packets (such as file transfers) by fragmenting the large ones and interleaving voice packets between them.
- IP Precedence marking—Ensures SAP traffic receives high priority by marking the IP Precedence bits of SAP traffic with a priority of four (five is the highest ranking, reserved for voice).
- Weighted Fair Queuing (WFQ)—Uses IP Precedence markings to schedule interactive SAP traffic to the front of the queue to reduce response time if no traffic from higher-priority voice flows is present.

Conexant's Environment

For local-area network (LAN) access, Conexant maintains the company's largest LAN of 4000 users at its Newport Beach headquarters. Cisco Catalyst 6500s are the core switches, and the company's engineering LAN includes both Catalyst 6500s in the core and Catalyst 5000s in the wiring closet. A central data center in Newport Beach houses most of the company's servers.

For WAN access, Conexant uses a variety of Cisco routers including 7500, 3600, and 2500 series running a range of Cisco IOS software from 11.2 up to 12.0(7)T. QoS was implemented on Conexant's Cisco multiservice 3640 routers (Figure 1). Domestic circuits include Frame Relay PVCs with speeds from 256 Kbps to T1, with 0 CIR (Committed Information Rate). High-speed circuits exist between the Newport Beach headquarters and San Diego, California (DS3); Newbury Park, California (DS3); and Mexicali, Baja California/Mexico (2 T1s). Internationally, circuits are also Frame Relay and range in speed from 64 Kbps to E1 with non-zero CIR PVCs.

Figure 1 Cisco 3640 Multiservice Routers Classify and Mark Voice and SAP Traffic Bidirectionally on Ingress Ports, then Perform Queuing and Fragmentation on the Egress Ports. The Result is Excellent Voice Quality and High SAP Performance Between Conexant's Newport Beach Headquarters and its Remote Sites.



For major applications, Conexant is running SAP version 3.1H across a logical three-tier, physical two-tier client-server architecture running on a Compaq Alpha back-end server. Conexant's SAP application serves 700 users, 200 of them concurrently. Conexant is also running the Promis application at Newport Beach for manufacturing operations, and is using Lotus Notes for electronic communications across distributed servers at remote locations.

Policy Tuning

Conexant used the consulting services of Netigy (www.netigy.com), a premier architect of e-business networks to help the company profile the SAP and voice applications, develop and test the QoS policies, and then implement the policies and perform validation. "Netigy was brought in because, in truth, very few people have the expertise in both network and application consulting like Netigy," says Colvin. "Their assistance saved us a lot of time and, ultimately, money in the implementation process."

"Our implementation methodology has four major phases: planning, design, implementation, and measurement," says Kevin Adams, Principal Consultant, Netigy. "The planning phase culminates in generating a business-requirements document. This is a 10-plus-page document that provides us an implementation road map. The document captures Conexant's business objectives, future needs, WAN, LAN, and application environment, scheduling, etc."

“During the design phase, we simulated Conexant’s voice, SAP, and background traffic and developed policies to service the voice traffic while protecting SAP, in competition with the background traffic. The simulation was especially important because we wanted to know exactly how the policy would improve application response time and impact network behavior. The results have been very impressive: We’ve provided the highest priority for voice, while simultaneously providing dramatic improvement in response time to SAP users.”

“The implementation of the actual policy itself contains two components: classification and enforcement.”

Classification

Packets are marked according to the level of priority using the IP type of service (ToS) field. Voice packets are first classified using the RTP port range from 16384 to 32767; and are then marked with IP Precedence five. SAP traffic is classified using the source IP address, as the SAP application is deployed on dedicated servers. SAP is then marked with IP Precedence of four. Traffic classification options also include protocol, host name, source/destination Transmission Control Protocol (TCP)/User Datagram Protocol (UDP) port information, source/destination IP address, or Network-Based Application Recognition (NBAR) for URL and other packet content-based classification.

Enforcement

Queuing and other QoS techniques were used for enforcement.

Netigy and Conexant set up three classes of service (three queues per interface):

- Gold—for delay-sensitive, real-time applications such as voice
- Silver—for critical, nondelay-sensitive applications such as SAP
- Bronze—for non-critical applications such as bulk file transfers or casual Internet browsing

For voice traffic, Netigy implemented IP RTP Priority which places voice in a strict priority queue; and this real-time queue will always be serviced before any other traffic so that delay and jitter with voice can be minimized and controlled. Priority queuing had previously been used for voice. Netigy found that, by implementing an enhanced IP RTP Priority policy for voice, Conexant could realize dramatic reductions in packet loss and jitter over priority queuing. (Figures 2 and 3)

Figure 2 Voice Packet Loss was Dramatically Reduced by Implementing an Enhanced IP RTP Priority Policy over the Baseline Priority Queuing Policy.

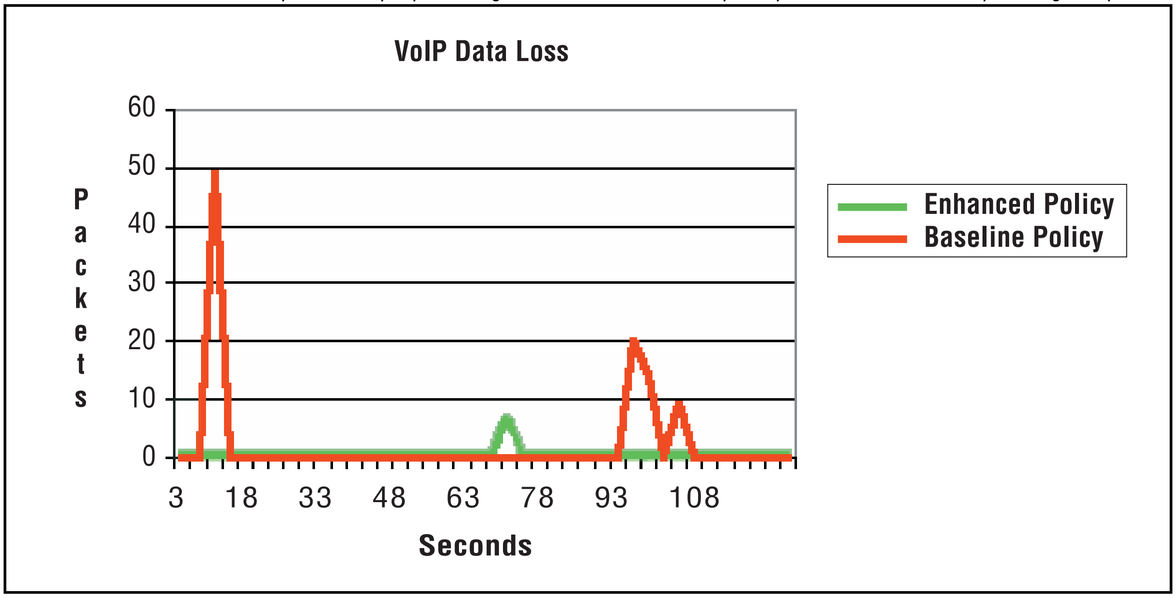
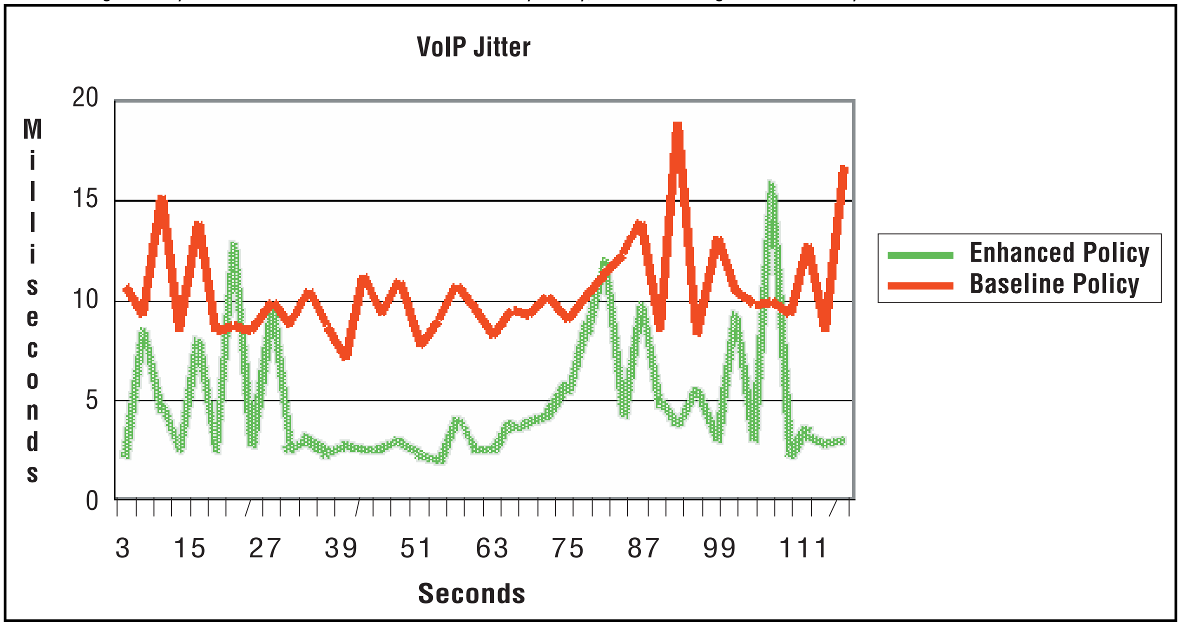


Figure 3 Jitter was Significantly Reduced with the Enhanced IP RTP Priority Policy; this Enables Higher Voice Quality.



After placing voice in a strict priority queue the next step was to determine an appropriate queuing mechanism for SAP traffic. An analysis of the SAP traffic convinced Netigy that a "softer" queuing technique such as WFQ would be most effective for SAP traffic. The traffic analysis, using packet distribution and transmission frequency for SAP, indicated that SAP generated small low-volume packets, a situation where WFQ works well.

As the SAP packet distribution histogram in Figure 4 shows, the majority of Conexant's SAP packets are small—up to 127 bytes. The low-volume nature of the SAP traffic is illustrated in Figure 5, which shows a small number of packets being transmitted over time and a low consumption of bandwidth. The SAP transmission rate averages only 10 packets/sec and consumes an average of only 22 Kbits/sec. of bandwidth.

Figure 4 SAP Packet Distribution Histogram, Showing a Majority of Small-Sized Packets.

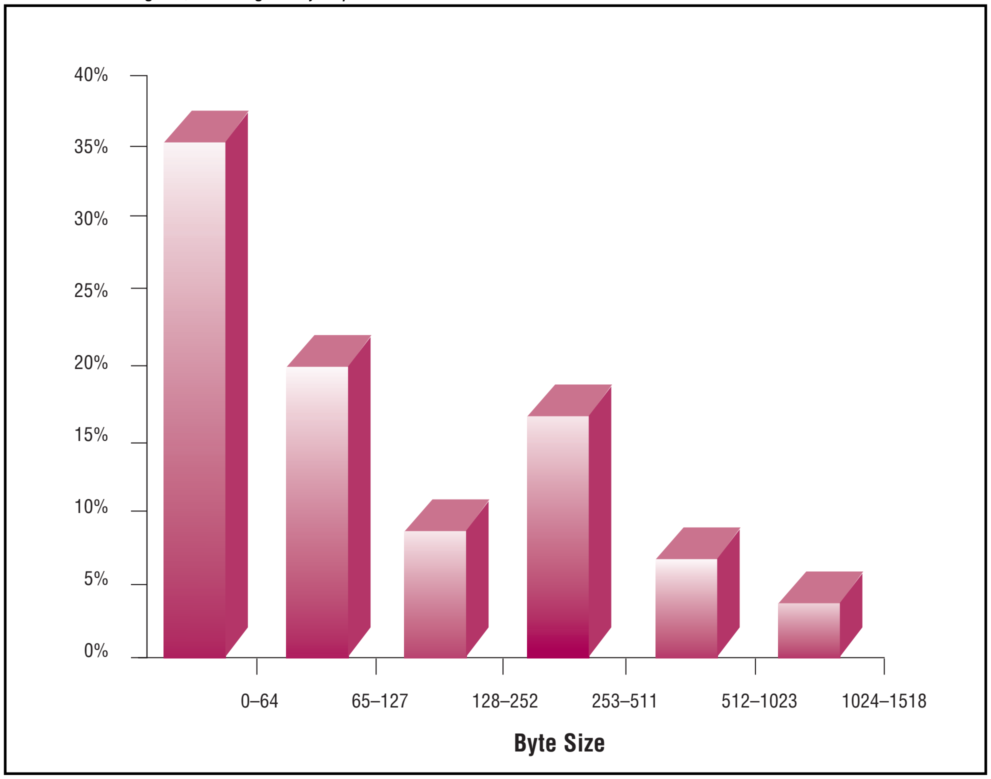
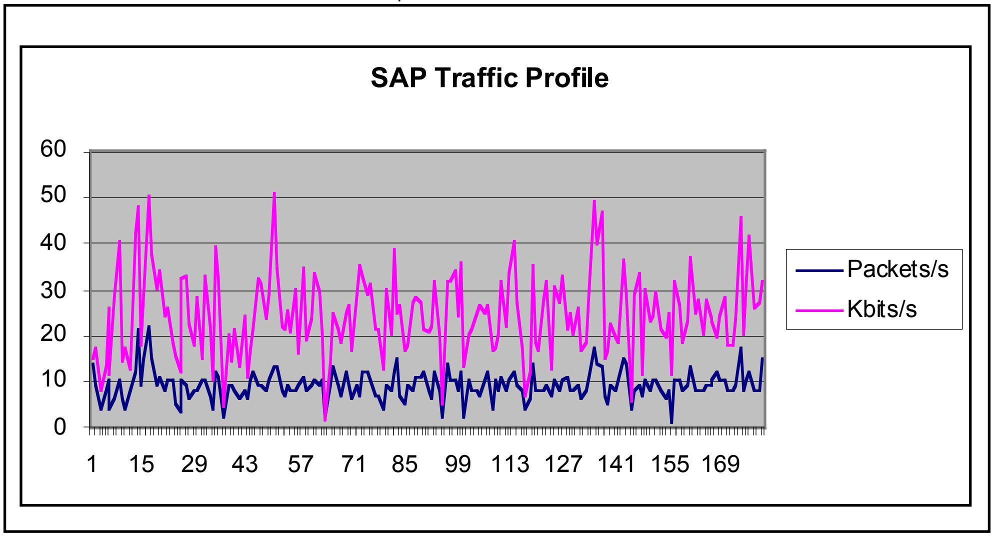


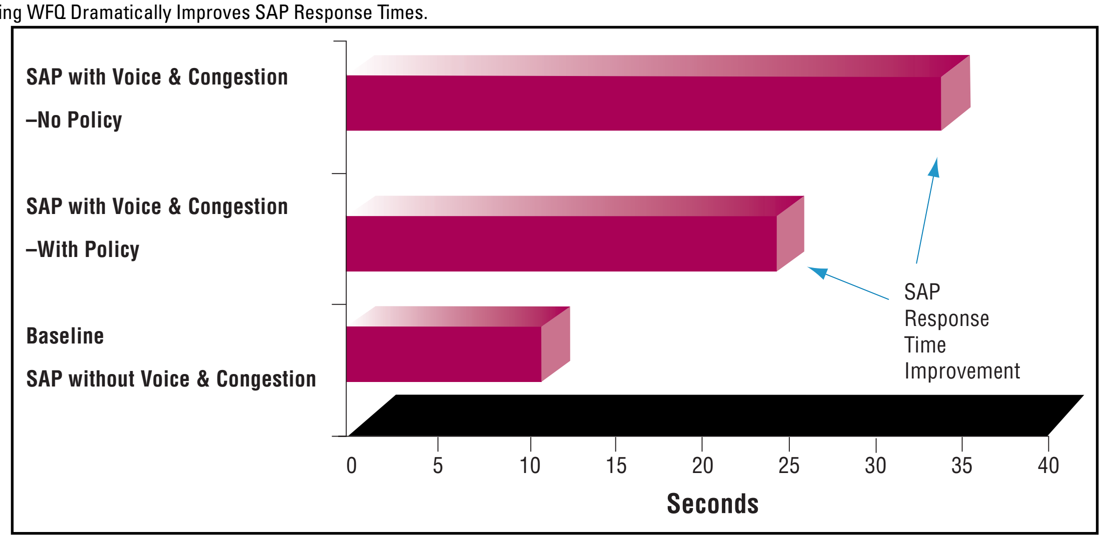
Figure 5 Conexant's SAP Traffic Transmits a Small Number of Packets per Second and Consumes a Small Amount of Bandwidth.



This type of traffic profile lends itself to WFQ, as WFQ gives small low-volume traffic priority over large high-volume traffic. WFQ sets up multiple queues, one for each conversation or flow, and provides higher bandwidth to those queues with a higher IP Precedence setting. The IP Precedence of SAP traffic was set to four so all queues with SAP traffic were given greater bandwidth than background traffic with lower IP Precedence settings.

By adding WFQ, SAP response times improved significantly as shown in Figure 6, from 35 seconds to 25 seconds. The time represents the time required to complete one SAP sales order requiring nine separate transactions. This dramatic improvement was possible even after already placing voice in a strict priority queue.

Figure 6 Adding WFQ Dramatically Improves SAP Response Times.

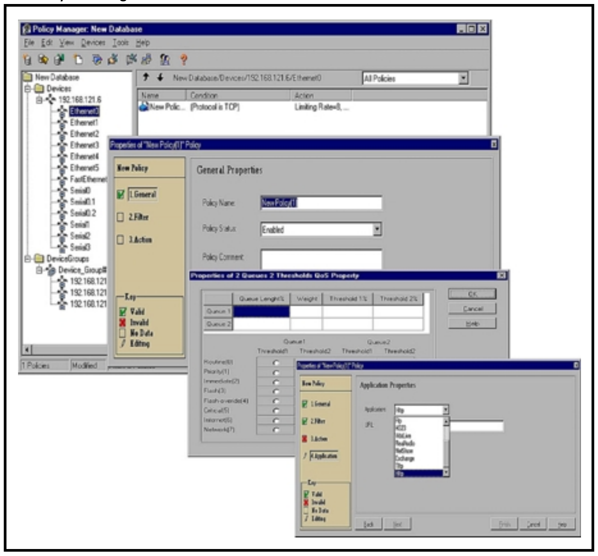


QoS Policy Manager

Conexant installed the Cisco graphical user interface (GUI)-based QoS Policy Manager (Figure 7), which centralizes and automates policy management. Moreover, QPM dramatically increases the speed and accuracy of defining, validating, configuring, and deploying QoS policies. QPM received Network Computing's Editors' Choice Award. <http://www.nwc.com/1024/1024f13.html>

Cisco QPM is a GUI- and rules-based policy manager that allows administrators to define, administer, manage, and distribute QoS policies automatically. QPM, running on Microsoft Windows NT, supports a comprehensive list of Cisco routers, Catalyst switches and software releases; and that device information can be downloaded from CiscoWorks2000. QPM is the industry's leading, award-winning, directory-enabled policy manager supporting advanced features such as COPS, RSVP, and Voice. For more information on QPM, see http://www.cisco.com/warp/public/cc/cisco/mkt/enm/cap/qospm/prodlit/index.shtml.

Figure 7 Cisco QPM is a GUI- and Rules-Based Policy Manager.



"Before QPM, we had to build and deploy QoS policies one router at a time using the command-line interface (CLI)," says Colvin. "It was time consuming and error prone. With QPM, it's easy to get the routers into the GUI interface, to define the policies for multiple routers, and to then push the polices to all of them at once. It's been a big time saver and has improved policy consistency."

As QoS policies are distributed to network devices, they are converted, by QPM, into specific classification, queuing, limiting, and shaping configuration commands. This reduces the complexity of configuring a mix of QoS features across a myriad of different devices, Cisco IOS versions, and Catalyst OS releases. Figures 8 and 9 illustrate the differences between using QPM versus manually configuring QoS using the CLI.

Figure 8 Shows the Ease of Defining QoS Policies within QPM.

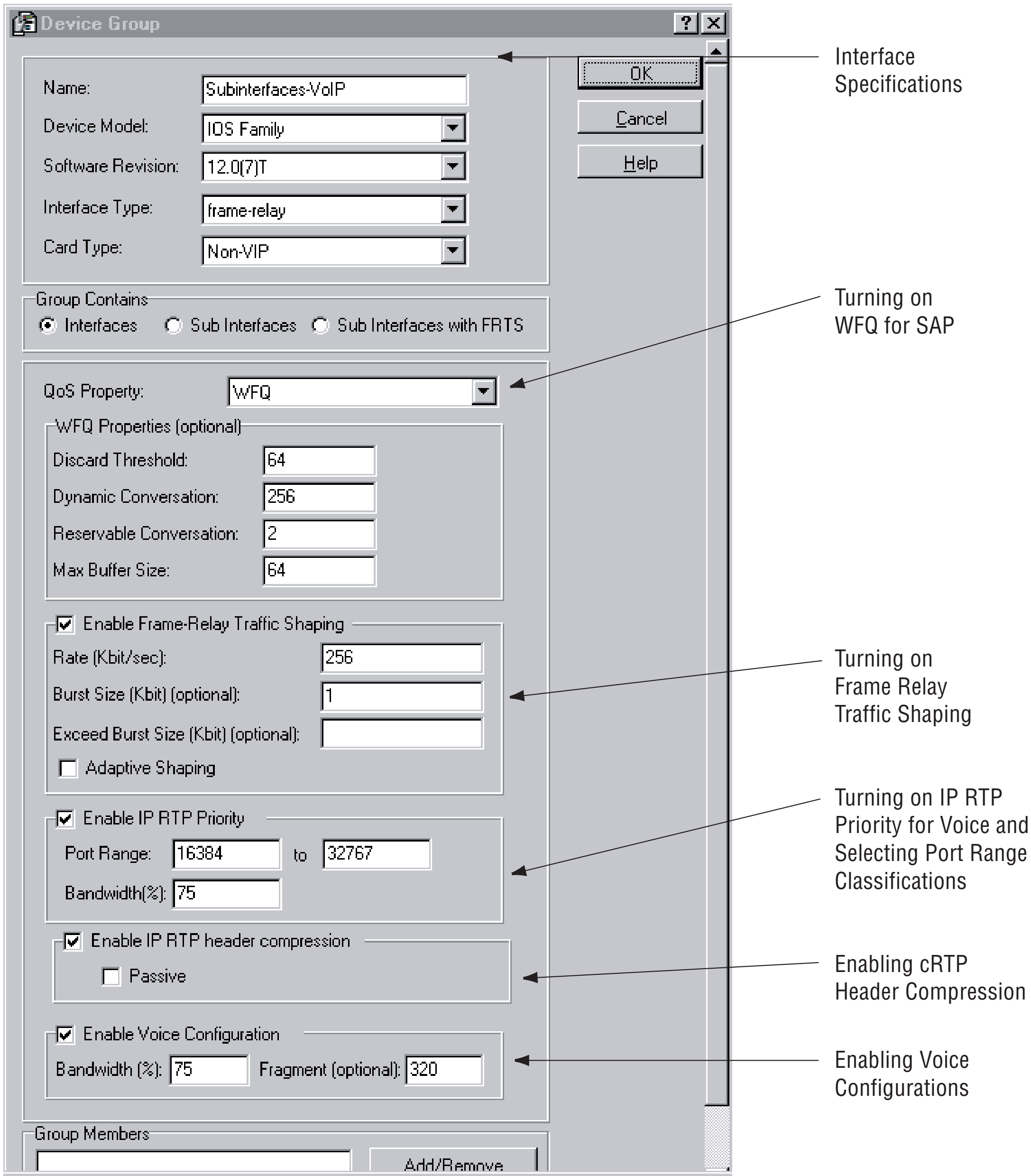


Figure 9 Shows the Corresponding CLI Commands that QPM Generates. Without QPM these Commands Would Need to be Manually Generated and Entered.

View Commands :"192.168.78.1"

File Edit Search

```
interface Serial0/0.5
no frame-relay class CDSI_512
exit
no map-class frame-relay CDSI_512
interface Ethernet0/0
rate-limit input access-group 100 8000 8000 8000 conform-action set-prec-transmit 4 exceed-action set-prec-transmit 4
exit
interface Serial0/0.5
frame-relay ip rtp header-compression
exit
interface Serial0/0.5
frame-relay class CDSI_54
exit
map-class frame-relay CDSI_54
frame-relay cir 256000
frame-relay bc 1000
frame-relay voice bandwidth 192000
frame-relay fragment 320
no frame-relay adaptive-shaping
frame-relay fair-queue 64 16 64 1
frame-relay ip rtp priority 16384 16383 192
exit
access-list 100 permit tcp 0.0.0.0 255.255.255.255 range 3000 3005 0.0.0.0 255.255.255.255
access-list 100 permit tcp 0.0.0.0 255.255.255.255 0.0.0.0 255.255.255.255 range 3000 3005
write memory
```

Results

"We have some very tangible results from implementing Cisco QoS features," says Colvin. "For example, we are now running data and voice over one PVC between Santa Clara and Newport Beach. What's more, we are getting excellent voice quality over the link and superior performance of the SAP applications. Users don't even know that their call is being routed over the data network, and that's impressive.

"While we are seeing obvious savings from the elimination of the PVC domestically, we're seeing the most dramatic savings internationally across our Tokyo/Newport Beach connection. Currently, we are using two PVCs. But, thanks to QPM, we've been able to move our voice traffic that was previously handled over the PSTN onto the existing PVCs. This is saving Conexant $4200 a month in toll calls, for just one link. In the near future, we expect additional savings of approximately $1000 a month when we eliminate the second PVC. We've been pretty happy with our QoS and QPM implementation."

CISCO SYSTEMS

Corporate Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 526-4100

European Headquarters
Cisco Systems Europe
11, Rue Camille Desmoulins
92782 Issy Les Moulineaux
Cedex 9
France
www.cisco.com
Tel: 33 1 58 04 60 00
Fax: 33 1 58 04 61 00

Americas Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
www.cisco.com
Tel: 408 526-7660
Fax: 408 527-0883

Asia Pacific Headquarters
Cisco Systems Australia, Pty., Ltd
Level 17, 99 Walker Street
North Sydney
NSW 2059 Australia
www.cisco.com
Tel: 61 2 8448 7100
Fax: 61 2 9957 4350

Cisco Systems has more than 190 offices in the following countries. Addresses, phone numbers, and fax numbers are listed on the
Cisco.com Web site at www.cisco.com/go/offices.

Argentina • Australia • Austria • Belgium • Brazil • Canada • Chile • China • Colombia • Costa Rica • Croatia • Czech Republic • Denmark • Dubai, UAE
Finland • France • Germany • Greece • Hong Kong • Hungary • India • Indonesia • Ireland • Israel • Italy • Japan • Korea • Luxembourg • Malaysia
Mexico • The Netherlands • New Zealand • Norway • Peru • Philippines • Poland • Portugal • Puerto Rico • Romania • Russia • Saudi Arabia • Singapore
Slovakia • Slovenia • South Africa • Spain • Sweden • Switzerland • Taiwan • Thailand • Turkey • Ukraine • United Kingdom • United States • Venezuela

09/00 BW6498